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HP Xenon by d-DNP using the clinical GE SPINlab polarizer system

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Purpose: Hyperpolarized (HP) ^{129}Xe for magnetic resonance (MR) has wide use in material sciences, structural chemistry and medicine. In the medical field ^{129}Xe has been demonstrated as a useful probe for MR lung imaging and proposed as a blood tracer for *in vivo* perfusion imaging[1]. The Xenon probe is therefore promising for clinical assessment of brain function[2], and may aid in the diagnosis and prognosis of brain diseases. Standard production of HP ^{129}Xe is via spin exchange optical pumping (SEOP). However, reports of large polarization enhancements for ^{129}Xe via dynamic nuclear polarisation (DNP)[1,3] have raised expectations that DNP can be an alternative method for producing HP ^{129}Xe for patients. We therefore investigated the possibility for production of HP ^{129}Xe using the clinical GE SPINlab polarizer, extending the practical use of the system.

Materials and methods: Solid state samples of 0.80±0.01 mL 1-Propanol / 12 mM AH111501 radical, infused with natural abundance (n.a.) or enriched (70% ^{129}Xe) Xenon gas at 5.0±0.2 bar partial pressure for 60±1 minutes at room temperature, were prepared and inserted into the 5 T SPINlab polarizer. Microwaves at 140.01 GHz were used to irradiate the samples for 150±2 minutes at 0.90±0.04 K followed by dissolution, transport and MR measurement. HP / thermal MR experiments were performed (n = 3 / 2) with 9°±1° / 90°±1° flip angles and TR = 1 s / 300 s on a 9.4 T small bore rodent MR scanner using a volume radio frequency (RF) coil with 1 / 200 averages. Transport times for the n.a. / enriched gas experiments were 32±1 s / 27±1 s at earth field.

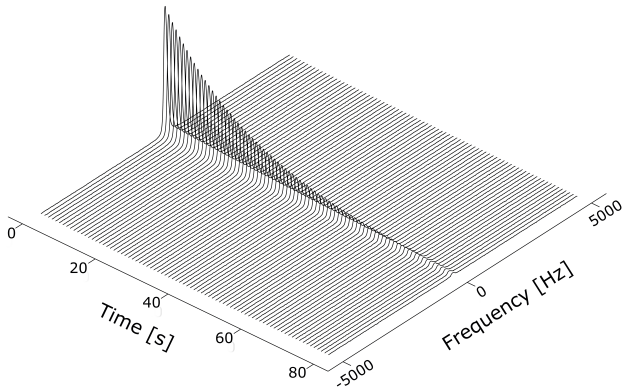

Figure 1: Decay of one of the recorded enriched HP ^{129}Xe spectra after phasing and exponential line broadening.

Results: The experiments resulted in enhancements / polarizations of 214±22 / 0.18±0.02 % and 431±30 / 0.37±0.03 % with T_1 = 29±2 s and 26±2 s for n.a. and enriched gas, respectively.

Conclusion: The experiments have shown that it is possible to hyperpolarize ^{129}Xe using the SPINlab system. However, substantial work is required to achieve similar enhancements to SEOP. Strides should also be taken to prolong the T_1 lifetime of the resulting HP gas. These issues can be addressed on multiple fronts, including optimization of the radical and Xenon concentrations, using different solvents and transporting the HP gas in a dedicated electromagnetic carrier.

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